Ultra-Early Blood Pressure Control in Aneurysmal Subarachnoid Hemorrhage

DNP Final Project

Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Nursing Practice in

The Graduate School of The Ohio State University

By

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The Ohio State University

2015

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Abstract

Background: The incidence of aneurysmal subarachnoid hemorrhage (aSAH) occurs in approximately 10 - 15 per 100,000 (Labovitz et al., 2006& Shea et al., 2007). Within twenty-four hours twenty-five percent of these patients die (AHA, 2012). Additionally two thirds have some neurological deficit and decreased quality of life (AHA, 2012). Re-bleeding is a serious complication prior to repair. The highest risk of re-bleeding occurs in the first twelve hours, most occurring in the first three hours with mortality rates as high as seventy percent (American Stroke Association [ASA], 2012). According to the ASA (2012), ultra-early blood pressure management is one of the most important interventions to prevent re-bleeding. These guidelines were updated May 2012 with recommendations to keep systolic blood pressure less than 160 mmHg. **Purpose:** The objective of this quality improvement project was to determine if the publication of the updated 2012 AHA/ASA aSAH Guidelines affected adherence, by Cleveland Clinic Critical Care Transport Team members, to those evidence based practice guidelines for blood pressure control for patients with subarachnoid hemorrhage. **Methods:** Descriptive statistics were used looking at secondary data from a retrospective chart review to examine blood pressure management during transport. The sample includes 137 patients transported by Cleveland Clinic Critical Care Transport with a diagnosis of aSAH in 2012. Data collected included length of transport in minutes and systolic blood pressures during transport. Data was analyzed and compared for the periods of January through June 2012 and July through December 2012. A chi-square test was used to see if there was a statistically significant change. **Results:** The data indicated there was not a statistically significant difference between the two groups. Adequate blood pressure management was achieved in eighty six percent of the patients in both groups. **Conclusion:** After a statistical review of the data was completed it was determined that there was not a statistically significant difference in adequate systolic blood pressure

management (SBP > 159 mmHg) following the July 2012 publication of the AHA/ASA guidelines.

Chapter One: Nature of Project

Introduction

Subarachnoid hemorrhage is a devastating type of hemorrhagic stroke that frequently occurs as a result of a ruptured intracranial aneurysm. Overall subarachnoid hemorrhage accounts for a very small percentage of all strokes, but this type is associated with significant morbidity and mortality (Suarez, Tarr & Selman, 2006). Approximately three quarters of spontaneous subarachnoid hemorrhages occur as a result of a ruptured intracranial aneurysm (Greenburg, 2006). Most aneurysmal ruptures occur between the ages of 40 – 60, but can occur at any age (Jordan et al., 2009). Incidence varies based on geographic region. The overall incidence of aneurysmal subarachnoid hemorrhage (aSAH) is estimated to occur in 10 – 15 per 100,000 people in the United States (Labovitz et al., 2006& Shea et al., 2007).

Within the first twenty-four hours approximately twenty-five percent of patients with aneurysmal subarachnoid hemorrhage die (AHA, 2012). Additionally two thirds of these patients have some degree of neurological deficit and decrease in quality of life (AHA, 2012). Aggressive medical and surgical management along with treatment in tertiary care centers that are experienced in the treatment of aneurysmal subarachnoid hemorrhages have been shown to improve functional outcomes (AHA, 2012). Many of these patients present to non-tertiary care centers without subspecialty care and therefore received less than optimal care, requiring transport to tertiary care centers.

The risk of re-bleeding is highest in the first twelve hours post aneurysmal rupture and is associated with the highest morbidity and mortality. It has been established that the worst outcomes are associated with re-bleeding that occurs in the first three hours (AHA, 2012). Re-bleeding continues to be a serious complication in aSAH. Aneurysmal re-bleeding is associated

with very high mortality and a poor prognosis for functional recovery if the patient survives the incident (AHA, 2012). The first three hours after rupture was defined as the early re-bleed period. The American Stroke Association states that the fatality rate in early rebleeding is seventy percent. Re-bleeding is currently one of the most treatable causes of poor outcomes with ultra-early blood pressure management being one of the important mainstays of treatment (American Stroke Association, 2012).

In May 2012 updated guidelines for the treatment of aneurysmal subarachnoid hemorrhages were published with recommendations for aggressive blood pressure management (American Stroke Association, 2012). This guideline is published through the American Stroke Association but is also endorsed by the American Academy of Neurology, American Association of Neurological Surgeons, Congress of Neurological Surgeons, Society of NeuroInterventional Surgery and American Heart Association. The 2012 AHA/ASA aSAH Guidelines aim to keep systolic blood pressure to less than 160 mmHg. There is general agreement among subspecialists that aggressive blood pressure management with a titratable medication for lowering blood pressure should be used until aneurysmal obliteration is accomplished (American Stroke Association, 2012).

Purpose of the Project

The primary purpose of project was to determine if there was improved blood pressure management in patients with subarachnoid hemorrhage after the publication of the updated AHA/ASA aSAH Guidelines that now include targeted blood pressure management. Recent management guidelines have been published that give explicit targets for clinical management of blood pressure for subarachnoid hemorrhage. These guidelines impact the care provided by the nurse practitioner. This project meets DNP Essentials II, III and VIII.

Significance of the Project

Ultra early blood pressure control in patients with aneurysmal subarachnoid hemorrhage during critical care can impact the healthcare systems at a macrosystem level. The nurse practitioner model of critical care transport promotes improved patient care through utilization of evidence based guidelines and goals. Encouraging optimal outcomes, decreasing complications and decreasing length of stay can ultimately affect the bottom line. Future quality improvement initiatives, increasing likelihood of Guideline adherence, resulting in decrease of incidence of re-bleeding could ultimately be linked to higher morbidity and mortality rates.

The Cleveland Clinic strives to be the world leader in patient experience, clinical outcomes, research and education (Cleveland Clinic, 2013). Their mission emphasizes the need to provide better care to the sick, investigation of their problems and to further the education of those who serve. In order to achieve this mission the organization ensures that quality underlies every decision. This is done through new technology, attracting the best staff, excellence in service and providing access to affordable health care.

The organization maintains high standards and achieves these standards through quality, innovation, teamwork, service, integrity and compassion. Quality improvement initiatives are continuously sought out. These initiatives aim to improve overall outcomes while providing world-class care to patients and exceeding patient expectations. Change is encouraged and embraced in order to find more efficient ways to achieve and exceed organizational goals. Teamwork is essential promoting collaboration and knowledge sharing between the professions while providing care with compassion and adhering to high moral standards. Above all the focus of care is based on “Patients First” (Cleveland Clinic, 2013).

Improving patient care and outcomes while preserving funds is essential in order for healthcare organizations to survive. Decreased funding, increasing number of uninsured or underinsured and decreased reimbursement from the insured have lead healthcare systems to seek out ways to deliver optimal patient care while providing more cost effective care. Decreasing complications, length of intensive care unit stay and hospital length of stay all promote improved outcomes while decreasing overall cost. Achieving these goals can also indirectly improve patient and family satisfaction.

Project Objective

The objective of the quality improvement project was to determine whether nurse practitioners involved in transport of aSAH patients adhered to the 2012 AHA/ASA aSAH Guidelines for blood pressure control in patients with subarachnoid hemorrhage. Improving blood pressure management early in the patients care may impact the risk of re-bleeding thus impacting morbidity and mortality and improving functional outcomes.

Chapter Two: Review of Literature

Theoretical Framework

Evidence-based practice (EBP) is a problem solving approach to clinical questions that incorporates the use of current evidence from well-designed studies, clinician's expertise, patient values and preferences (Melnyk & Fineout-Overholt, 2011). Implementing evidence-based practice has been shown to improve quality of care, improve outcomes, reduce cost and improve nurse satisfaction yet the majority of nurses are not consistently implementing it in the clinical setting (Melnyk et al., 2010). In order to improve outcomes, providers and healthcare systems need to have a comprehensive approach to implementation. By the year 2020 the Institute of Medicine has a goal that ninety percent of health care decisions and care will be evidenced based (Olsen, Aisner & McGinnis, 2007).

Integrating research into practice is best accomplished by using an evidence based practice model. One of these models is the Iowa Model of Evidence-Base Practice to Promote Quality Care (Titler, et al., 2001). This model was utilized for the analysis of blood pressure management in subarachnoid hemorrhage (Appendix A). The Iowa model is an organizational model addressing quality practice from a deductive reasoning approach (Titler, et al., 2001 & Fineout-Overholt, Melnyk & Schultz, 2005). There are nine phases included in the Iowa Model (Titler, et al., 2001):

1. Generation of a question
2. Determine relevance to the organization
3. Develop a team to gather and appraise evidence
4. Determine if the evidence answers the question

5. Determine if there is sufficient evidence to pilot the change in practice, if insufficient evidence, generate evidence through research or base practice on other types of evidence.
6. If the change is initiated on evidence, deem appropriateness of change to practice
7. Institute the change if appropriate
8. Evaluate structure, process and outcome data
9. Disseminate results

Initially it is essential to identify a problem or trigger that requires change and is relevant to practice. Cost effective changes are often high priority for many organizations and the Iowa Model assists with cultivating the spirit of inquiry. The Organization must cultivate a spirit of inquiry among staff and clinicians. Institutions must buy into the concept of providing evidence-based practice. Cost effective changes are often high priority for many organizations. When choosing the problem or trigger one must consider whether the problem identified is a priority for the institution and whether evidence-based practice is part of the institutional culture (Titler et al., 2001). Many quality improvement initiatives are goals of the institution and often require incorporating evidence-based practices.

It is often helpful to develop a team approach for implementing a change in practice. The team can be responsible for all parts including development, implementation and evaluation of the evidence-based change. The composition of the team should include all stakeholders who have an interest in the chosen population. Without the necessary resources and leadership support, the team will likely struggle to succeed (Feasey & Fox, 2001). Staff support is

essential; frontline staff must be included and help drive the change for success (Gagan & Hewitt-Taylor, 2004).

Minimal data is available related to ultra-early blood pressure control and compliance with the published 2012 AHA/ASA aSAH Guidelines in the Emergency Department and Critical Care Transport setting. However the time period immediately following start of the hemorrhage is the most critical in terms of preventing re-bleeding and poor outcomes. Ultra-early blood pressure management prior to surgically securing the aneurysm is one of the measures used to prevent re-bleeding from occurring therefore decreasing the overall risk for poor neurological outcomes and was the focus of the proposed quality initiative.

Related Research

Subarachnoid hemorrhage frequently occurs as the result of a ruptured intracranial aneurysm. Overall subarachnoid hemorrhages only account for approximately ten percent of all strokes, but are associated with significant morbidity and mortality (Suarez, Tarr & Selman, 2006). Approximately seventy-five percent of spontaneous subarachnoid hemorrhages occur as a result of a ruptured intracranial aneurysm (Greenburg, 2006). The overall incidence of aneurysmal subarachnoid hemorrhage (aSAH) is estimated to occur in 10 - 15 per 100,000 people in the United States (Labovitz et al., 2006& Shea et al., 2007). This number is thought to be a low estimate because of factors such as misdiagnosis, death prior to arrival to hospital and the possibility of the omission of post aSAH autopsies (Kowalski, & Claassen, 2004).

Approximately twenty-five percent of patients with aneurysmal subarachnoid hemorrhage will die within the twenty-four hours (AHA, 2012). Additionally two thirds of these patients will have some degree of neurological deficit and decrease in quality of life (AHA, 2012). Aggressive medical and surgical management combined with treatment in tertiary care centers

that are experienced in the treatment of aneurysmal subarachnoid hemorrhages (aSAH) has been shown to improve functional outcomes (AHA, 2012). Many of these patients present to non-tertiary care centers that are without subspecialty care and therefore received less than optimal care, requiring transport to tertiary care centers.

Intracranial aneurysm formation and subsequent rupture is a complex multifactorial process that is not well understood. Many factors can impact the outcome of aSAH including age, sex, race, and location of aneurysm and subarachnoid bleed (AHA, 2012). Outcomes following aSAH are primarily determined by the severity of the initial bleed, the occurrence of early re-bleeding, and delayed cerebral ischemia secondary to vasospasm (AHA, 2012). The primary causes of poor outcome and decreased neurological outcome are related to the initial bleeding and sequelae that follow (le Roux & Wallace, 2010). The Cooperative Study on Timing of Aneurysm Surgery found that the direct causes of patient mortality were, in order of prevalence, related to cerebral infarction due to vasospasm, direct effect of hemorrhage, re-bleeding, treatment complications and hydrocephalus in order of prevalence (Kassell, et al., 1990).

The highest risk of re-bleeding occurs in the first twelve hours. Most re-bleeds occur in the first three hours and are associated with mortality rates as high as seventy percent (American Stroke Association [ASA], 2012). Re-bleeding continues to be a serious complication in aSAH. Re-bleeding is one of the currently most treatable causes of poor outcomes with early blood pressure management being one of the important mainstays of treatment (American Stroke Association, 2012).

In May 2012 AHA/ASA aSAH updated Guidelines for the treatment of aneurysmal subarachnoid hemorrhages were published with recommendations for aggressive blood pressure

management (AHA, 2012). This guideline is published through the American Stroke Association but is also endorsed by the American Academy of Neurology, American Association of Neurological Surgeons, Congress of Neurological Surgeons, Society of NeuroInterventional Surgery and American Heart Association. The 2012 AHA/ASA aSAH Guidelines aim to keep systolic blood pressure to less than 160 mmHg. There is general agreement among subspecialists that aggressive blood pressure management with a titratable medication for lowering blood pressure should be used until aneurysmal obliteration is accomplished (AHA, 2012).

Ruptured aneurysmal subarachnoid hemorrhage is a life-threatening event that often presents with a dramatic clinical presentation. Many times patients experience a sudden severe headache, loss of consciousness, altered mental status and neurological impairment. In many cases these symptoms create overwhelming stress and distress to patients and families. During the initial post-rupture period, neurological symptoms may progress rapidly requiring aggressive intervention and treatment to preserve function and improve overall outcomes. In many cases these symptoms create overwhelming stress and distress to patients and families (Buchanan, et al., 2000).

Several studies have shown that patients and significant others have persistent symptoms such as anxiety, depression, stress and sleep disturbances that progress to impair work, quality of life and family functioning (Buchanan, et al., 2000; Hellawell, & Pentland, 2001; Mezue et al., 2004). These studies have also shown that significant others and family members can have higher levels of distress than the patients (Buchanan, et al., 2000; Pritchard et al., 2001). Patients and family members are often stressed and show signs of distress from the initial presentation through discharge. Providing high quality care along with adequate support can impact the

patient and family during hospitalization and post discharge. In order to prevent post-traumatic stress disorder in these patients and families providers and staff must provide adequate communication, proper consultation and support. A high percentage of patients and families of patients who experience subarachnoid hemorrhage have post-traumatic stress disorder. Adequate support and care can prevent this disorder and affect the overall health of the patient and family (Buchanan, et al., 2000).

Chapter Three: Methods

Project Design

The objective of this quality improvement project was to determine if the publication of the updated 2012 AHA/ASA aSAH Guidelines affected adherence, by Cleveland Clinic Critical Care Transport Team members, to those evidence based practice guidelines for blood pressure control for patients with subarachnoid hemorrhage, by comparing chart data from the period January through June 2012 with chart data for the period July through December 2012. Improving blood pressure management early in the patient's care may impact the risk of re-bleeding thus impacting morbidity and functional outcomes, as well as mortality.

The data for this project was extracted from an original study, of a retrospective chart review looking at all patients with a diagnosis of intracranial hemorrhage transported by Cleveland Clinic Critical Care Transport Team in years 2011 and 2012. A secondary analysis of the data was completed including all patients transported in 2012 with a diagnosis of subarachnoid hemorrhage transported by Cleveland Clinic Critical Care Transport Team. The original data came from a Cleveland Clinic study undertaken to identify whether if blood pressure control impacted hematoma expansion in patients with intracranial hemorrhage.

The design of the project used a quantitative and descriptive design looking at adherence to established goal blood pressure targets. Analysis of the data was completed and determines the number of patients to have adequate blood pressure control upon arrival to the receiving unit. The data was also analyzed to identify if there was increased adherence to evidence based practice after the update of review of the published 2012 AHA/ASA aSAH Guidelines that occurred in June 2012. Data was compared from January through June 2012 to July through December 2012.

The setting for the project was a tertiary care center with a hospital based critical care transport system utilizing rotor wing, fixed wing and ground transport for critical care transport. The proposal for the project was submitted to The Ohio State University and Cleveland Clinic Institutional Review Boards for exemption status based on quality improvement. This project involved retrospective review of patient records, does not involve a vulnerable population, and poses no risk to the participants.

Sample

The adult critical care transport team of this project transports approximately three hundred patients each year with a diagnosis of intracranial hemorrhage. Of these approximately one third had an admission diagnosis of subarachnoid hemorrhage. Inclusion criteria included records from all patients during the calendar year 2012 diagnosed with subarachnoid hemorrhage by health professionals located at the sending facility, who were then transported by the Cleveland Clinic adult critical care transport team. Records from patients transported by any other transport team were excluded.

Methods

Variables extracted included trip duration, diagnosis and blood pressures during transport. No data was missing or incomplete; industry standards for complete data had been followed. The study data consisted of an audit of pre-existing data of completed missions; therefore attrition was not a factor.

For the initial study trained abstractors were used to collect the data using a standardized form to provide for inter-rater reliability. The abstractors were critical care transport nurses who were familiar with the population of patients and the charting process. Each abstractor received education on the collection of data points and how to enter the data into the RedCap database. Quality audits for data collection were performed to ensure inter-rater reliability and quality of

data entered. The data was entered directly into the RedCap online data collection form and stored securely on the RedCap server. Accessing the data requires individuals to be identified study personal of the study through Cleveland Clinic IRB and to login using Cleveland Clinic access to all study information. Secondary data was exported into a spreadsheet format and stored in a secure manner.

No additional review process was necessary. The project was feasible in the amount of time allotted. It was estimated that approximately one hundred patients were transported with a diagnosis of subarachnoid hemorrhage in 2012. This number of data was manageable for the allotted time.

Instruments

Data was obtained from the electronic medical record or paper record based upon the mode of transport and chart used during transport. The data points were directly entered into the RedCap data repository. Variables to be extracted include trip duration, diagnosis and blood pressures during transport. The number of data entry points varied among each transport based upon total length of transport and number of vital signs obtained during transport. This data was placed into an Excel database in order to analyze the data points and information. These variables were collected to identify if adequate blood pressure control was obtained during the transport phase of care. Additional information and further analysis of the information obtained is projected for future studies.

Data Analysis

Data was analyzed to identify if adequate blood pressure control was obtained during critical care transport in patients with a diagnosis of subarachnoid hemorrhage. The results from this review were reported as de-identified aggregate information and will be presented as poster presentations, presentations and manuscript publication.

The secondary data was obtained through the RedCap repository and exported into an Excel spreadsheet for further analysis. The data included a total of 137 transports, including 64 observations prior to the publication of the guidelines and 73 observations after the publication of the guidelines. Data included length of transport in minutes, and blood pressures during transport. The data was collected from January to December 2012.

Descriptive statistics were used for data analysis. The means and standard deviations of blood pressure readings, number of readings and trip duration were calculated for all aggregated subjects, subjects whose data were collected prior to the updated guidelines and subjects whose data were collected after the updated guidelines. Final blood pressure readings were classified as low (systolic blood pressure 159 or less) or as high (systolic blood pressure 160 or above). The distributions of low and high observations were recorded as a function of period or time, before or after July 2012.

Statistical testing was applied to see if there were any on average group differences in final systolic blood pressure readings. The groups were also tested for differences in the percent of individuals with high systolic blood pressure readings with a systolic blood pressure of 160 or greater. A chi-square test was used to see if there was a statistically significant change in systolic blood pressure management after the publication of the guidelines using a p value=0.95.

Chapter Four: Findings

Description of the Sample

The Cleveland Clinic Critical Care Transport team provides scene and interfacility transport of critically ill or injured neonatal, pediatric and adult patients to tertiary and quaternary care centers. Each year approximately 5500 patients are transported globally (Cleveland Clinic, 2015). These transports are completed via rotor wing aircraft (helicopters), fixed wing aircraft (airplanes) and ground mobile intensive care units. The team is comprised of an acute care nurse practitioner, and a specialty trained and certified critical care nurse or paramedic. Other providers may be added based on individual patient needs.

The original research included records from all adult patients, age 18 and older, with a diagnosis of intracranial hemorrhage including hemorrhagic stroke, intracerebral hemorrhage, or subarachnoid hemorrhage, which had been transported during calendar year 2011 and 2012. Records of patients diagnosed with subdural hematoma and epidural hematoma were excluded. Only records from patients transported by the Cleveland Clinic Critical Care Transport Team were included in the original study; records of all other transports by other teams were excluded. Out of the approximate 5500 patients transported, 327 patients diagnosed with intracranial hemorrhage were transported in 2012. Of these, 137 patients had a working diagnosis of acute aneurysmal subarachnoid hemorrhage and their records were included in the DNP project.

The project looked at all of the 137 diagnosed with aSAH transported by the Cleveland Clinic Critical Care Transport Team in 2012 as an aggregate as well as patients who were transported from January through June 2012 and July through December 2012. Patients transported from January through June 2012 were transported prior to publication of the 2012 AHA/ASA Guidelines, and patients transported July through December 2012 were transported following publication of the 2012 AHA/ASA Guidelines. Data obtained from the records

included length of transport in minutes and blood pressures during transport. Number of blood pressures varied based on overall clinical status, discretion of the nurse practitioner and length of transport. The 137 patient records were separated into two groups according to trip completion date. There were 64 patients transported January through June and 73 patients transported July through December.

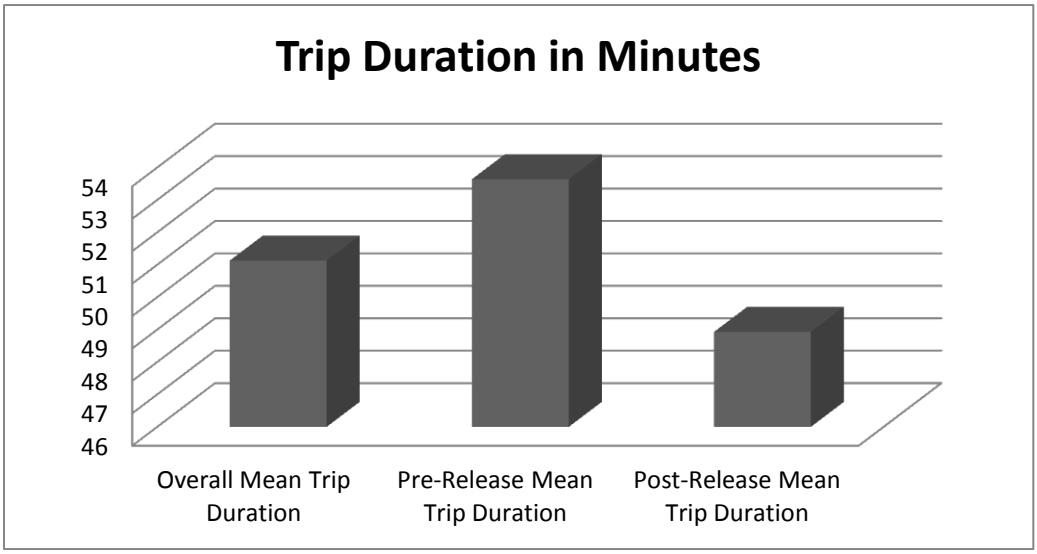
Results

After the data set was obtained from the RedCap database, descriptive statistics were used to for a secondary analysis the data for this project. The data was broken down into the overall data with an N of 137 subjects, as well as the pre-publication subjects, n of 64, and post-publication subject, n of 73. Table 1 provides a summary of the data collected measuring the means, minimums and maximums as well as standard deviations for trip durations, number of blood pressure readings, first blood pressure readings and final blood pressure readings. These readings were listed for overall combined subjects, those collected before and after the distribution of the 2012 AHA/ASA aSAH Guidelines

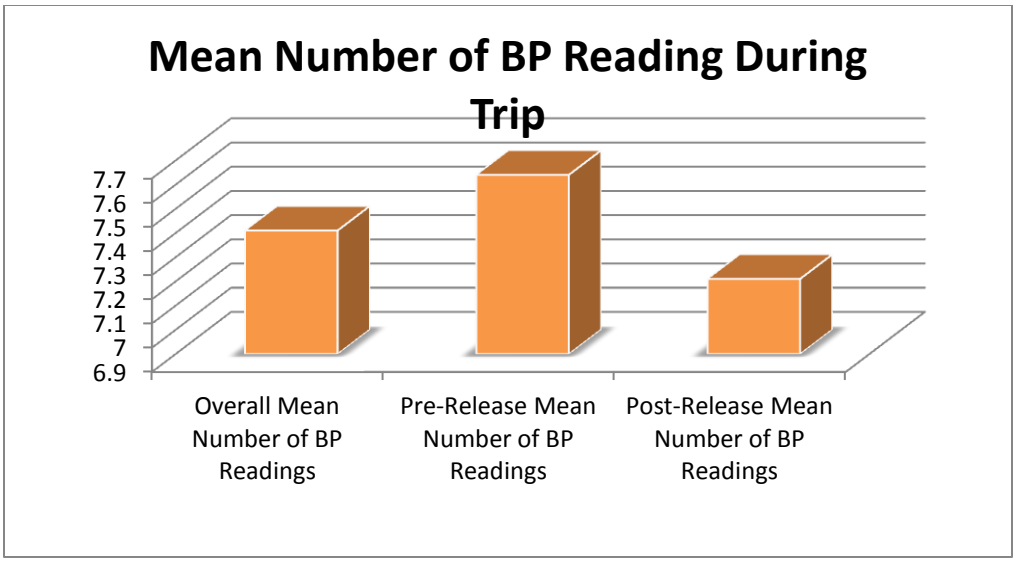
The first variable analyzed was duration of the transport, labeled duration of trip. Duration of trip was measured as the time of arrival at the bedside of the sending facility to time of arrival at the bedside of the receiving facility. This time includes transit time from mode of transport to bedside. Duration of trip does not directly impact blood pressure control during transport but can impact the time available in order to achieve adequate blood pressure control and time available for treatment.

The overall mean of the duration of trip includes both the pre-publication and post-publication groups combined and was calculated as a mean as 51.13 minutes with a range of

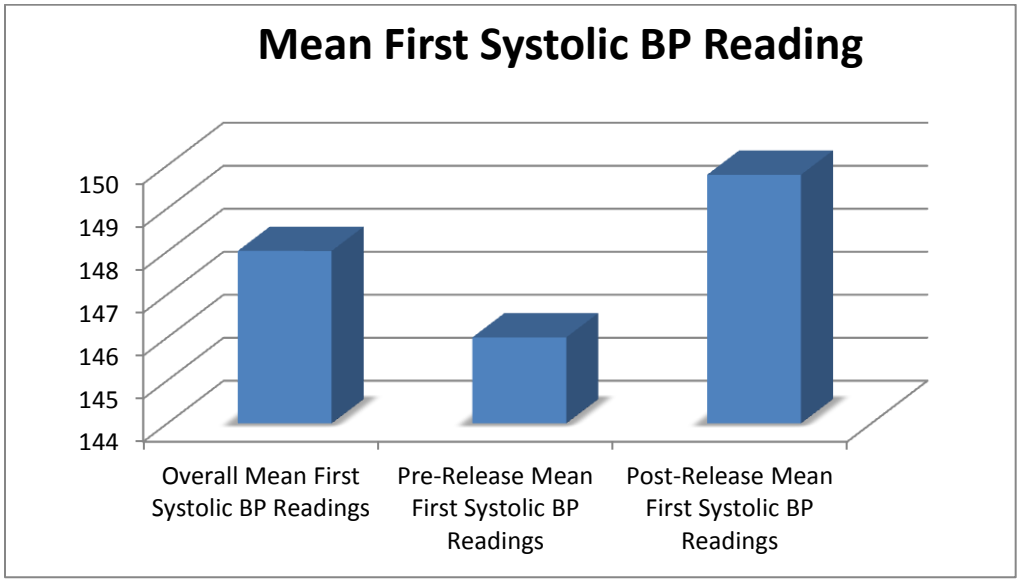
duration of trip of 20 minutes to 137 minutes. The pre-publication group duration of trip mean was calculated as 53.64 minutes with a range of 23 minutes to 137 minutes. Post-publication group mean duration of trip was calculated as 48.93 minutes with a range of 20 minutes to 110 minutes. (See Table 1).



The second variable analyzed was the number of blood pressure readings during the duration of the trip. This number varied based on clinical condition, trip duration and individual nurse practitioner management. This variable was also analyzed as an overall mean with pre-publication and post-publication means calculated. The overall mean number of blood pressure readings during a trip was found to be 7.41 with a range of one to fifteen. The mean number of blood pressure readings in the pre-publication group was found to be 7.64 with a range of one to fifteen. The mean number of blood pressure reading in the post-publication group was 7.21 with a range of three to fifteen. (See Table 1).



The third variable analyzed was the first systolic blood pressure obtained. This was calculated as a mean with a range and was looked at as overall, pre-publication and post-publication. The mean first systolic blood pressure in the overall group was 148.01 with a range of 56 mmHg to 257 mmHg. The mean first systolic blood pressure in the pre-publication group was 146 mmHg with a range of 56 mmHg to 257 mmHg. The post-publication mean was 149.78 mmHg with a range of 86 mmHg to 222 mmHg. (See Table 1).



The last variable analyzed was the final systolic blood pressure obtained during transport. This was the last blood pressure taken by the critical care transport team prior to ”hand-off” of care to the receiving facility. The final systolic blood pressure was calculated as a mean with a range for overall, pre-publication and post-publication. The overall mean systolic blood pressure was calculated at 137.12 mmHg with a range of 77 mmHg to 190 mmHg. The pre-publication mean final systolic blood pressure was 138.05 mmHg with a range of 77 mmHg to 190 mmHg. The post publication mean final systolic blood pressure was calculated at 136.32 mmHg with a range of 90 mmHg to 186 mmHg (See Table 1).

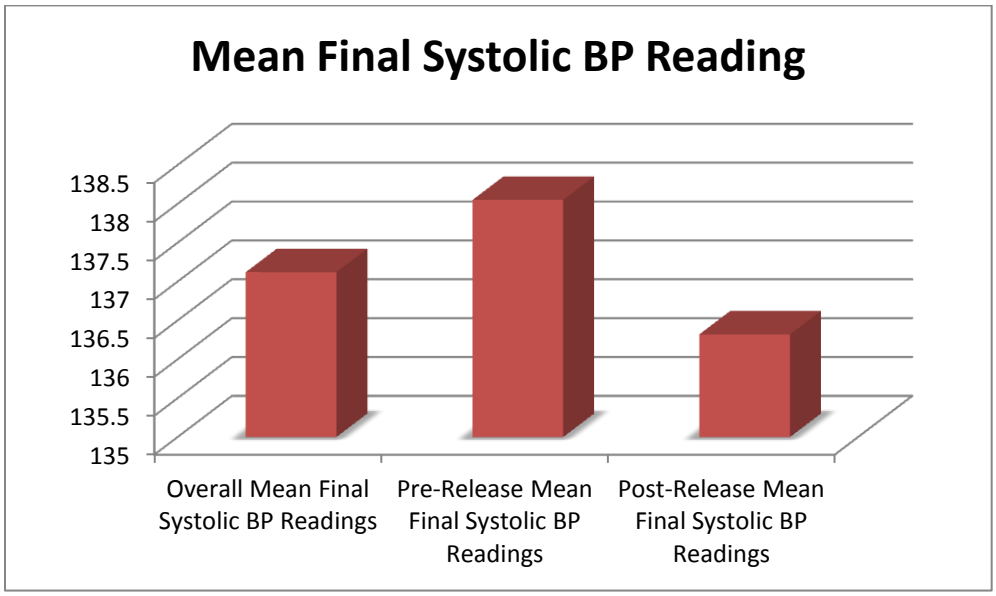


Table 1. Distribution of SBP, # of SBP readings, trip duration as a function of period

	After Publication: 1=Yes, 0=No														
	0					*1*					*Overall*				
	N	*Mean*	*STD*	*Min*	*Max*	*N*	*Mean*	*STD*	*Min*	*Max*	*N*	*Mean*	*STD*	*Min*	*Max*
Duration	64	53.64	20.27	23.00	137.00	73	48.93	17.81	20.00	110.00	137	51.13	19.07	20.00	137.00
# BP readings	64	7.64	2.90	1.00	15.00	73	7.21	2.89	3.00	15.00	137	7.41	2.89	1.00	15.00
First SBP	64	146.00	29.81	56.00	257.00	73	149.78	29.58	86.00	222.00	137	148.01	29.64	56.00	257.00
Final SBP	64	138.05	22.96	77.00	190.00	73	136.32	20.48	90.00	186.00	137	137.12	21.61	77.00	190.00

Final blood pressure readings were then classified as low (159 mmHg or below) or high (160 mmHg or above). Table 2 provides the distribution of high and low observations as a function of period, overall and then in groups January through June and July through December 2012. The overall percentage of subjects with adequate systolic blood pressure control was calculated as 86.13%. The pre-publication subjects with adequate systolic blood pressure control was calculated as 85.94% with the post-publication as 86.3%. (See Table 2).

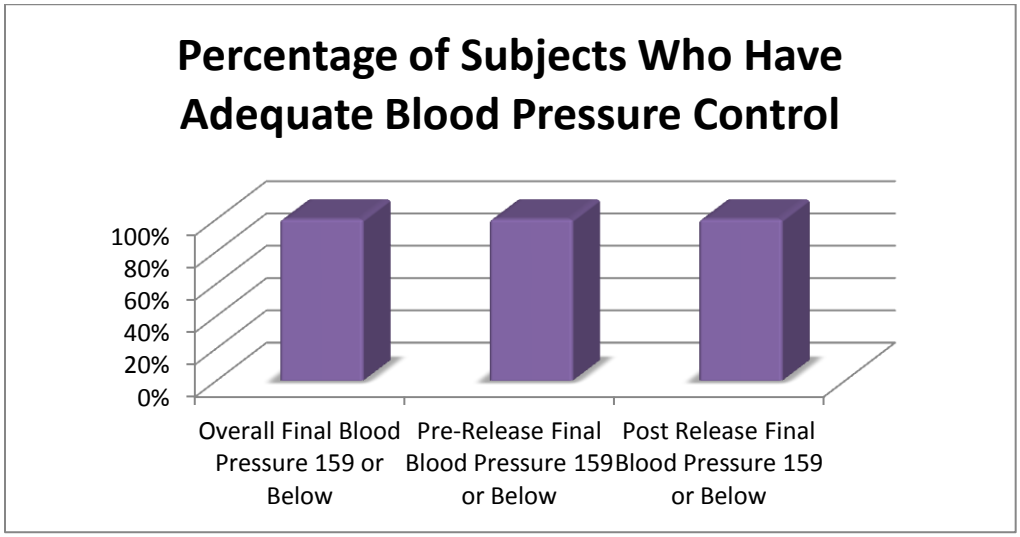


Table 2. Distribution final SBP (159 or below, 160 or above) as a function of period

	159 or below: 0=No 1=Yes,			
	0		*1*	
	N	*%*	*N*	*%*
After Publication: 1=Yes, 0=No				
0	9	14.06	55	85.94
1	10	13.70	63	86.30
Overall	19	13.87	118	86.13

Statistical testing was completed to identify whether there were any on average group differences in final blood pressure readings. Table 3 displays the results of a t test of group differences in final blood pressure readings. While the mean of the measurements taken from July through December was 1.7 units lower, the difference did not provide sufficient evidence of on-average group differences (See Table 3). Testing for group differences in the percent of individual with high blood pressure (160 mmHg or above) was also completed. The observed difference was a decrease of 0.36 percent. The difference between the 14.06% with inadequate systolic blood pressure control prior to the publication of the guidelines compared to the 13.7% after the publication of the guidelines. However, a chi-square test revealed that there was no a statistical significant difference (p value=0.95) after the publication of the guidelines (See Table 3).

Table 3. Group differences in last blood pressure reading.

			Before July		*After June*				
Variable	***Sample Size***	***Overall Mean (STD)***	***N***	***Mean (STD)***	***N***	***Mean (STD)***	***Difference Between Means (95% CI)***	***p Value***	***Effect Size (Cohen's d)***
LAST BP	*137*	*137.1 (21.6)*	*64*	*138 (23)*	*73*	*136.3 (20.5)*	*1.7 (-5.6, 9.1)*	*0.64*	*0.1*

Discussion

The objective of this quality improvement project was to determine if the publication of the updated 2012 AHA/ASA aSAH Guidelines affected adherence, by Cleveland Clinic Critical Care Transport Team members, to those evidence based practice guidelines for blood pressure control for patients with subarachnoid hemorrhage, by comparing chart data from the period January through June 2012 with chart data for the period July through December 2012. Aneurysmal re-bleeding is associated with very high mortality and a poor prognosis for functional recovery if the patient survives the incident ((AHA, 2012). The risk of re-bleeding is

highest within the first twelve hours with the most devastating outcomes with rebleeding in the first three hours. A systolic blood pressure > 160 mmHg has been associated with an increased incidence of re-bleeding (AHA, 2012).

Prior AHA/ASA Guidelines for aSAH did not address targeted blood pressures, as there was minimal evidence for a target blood pressure (AHA 2009). In the last edition discussions were included regarding the risk of re-bleeding with some evidence that blood pressure should be monitored and managed without specific targets mentioned (AHA 2009). The department of Neurosurgery at the Cleveland Clinic set a targeted systolic blood pressure of less than 160 mmHg for this subset of patients once admitted to the neurological intensive care unit (NICU). Even though this was a set standard in the NICU, there was minimal interaction between the admitting team (Neurocritical Care or Neurosurgery) and the critical care transport team.

In an attempt to determine whether publication of the 2012 AHA/ASA aSAH Guidelines had an effect on the Transport Team's practice, a secondary analysis of patient records with aSAH, transported by the Cleveland Clinic Transport Team, was obtained. This data was analyzed by reviewing the final systolic blood pressure obtained by the critical care transport team. After a statistical review of the data was completed it was determined that there was not a statistically significant difference in adequate systolic blood pressure management (SBP > 159 mmHg) following the July 2012 publication of the AHA/ASA guidelines.

Promoting the use of evidence based guidelines and practice is essential in order to optimize treatment and patient outcomes. The Cleveland Clinic Critical Care Transport Team is unique when compared to most critical care transport teams as it is staffed with an acute care nurse practitioner. Most critical care transport teams are staffed with a nurse who utilizes

protocols and is not able to individualize patient care. Patient care is individualized and treated accordingly. Prior to analyzing the data, it was expected that there would be an increase in adequate systolic blood pressure control after the publication of the guidelines when compared to the six months prior to the publication of the guidelines.

The data did, however, reveal that there was an overall success rate of adequate blood pressure control, (SBP 159 or less) in 118 out of 137 subjects or approximately eighty six percent, with the diagnosis of aSAH transported by the Cleveland Clinic Critical Care Transport Team in 2012. This data reveals a high rate of compliance with the new guideline. This suggests the potential for further quality improvement opportunities related to blood pressure control for this patient population, by this team.

There are likely barriers obtaining adequate blood pressure control during transport. Identified limitations will need to be further explored to see their impact on care provided during transport. Identified limitations included duration of trip, the need for stabilization upon arrival to the bedside, in-flight emergencies, procedures completed during transport, medication chosen for blood pressure control and frequency of blood pressure and medications given based on onset of action. All of these limitations could impact blood pressure management during critical care transport. However, these data points were not captured in the original data collection from the retrospective chart review. Lack of collected data imposes many limitation based on available information and data. The project was designed as a quality improvement project and not a research project. A hypothesis could not be formulated and additional research questions could not be addressed in this project.

It is essential to share the findings of the quality project with the critical care transport nurse practitioner group. Presenting the findings will promote the use of AHA/ASA 2012 guidelines and highlight the importance of ultra-early blood pressure control in aSAH. Combining a review session to present the data can serve as an education session, and may also motivate the group to improve performance.

Conclusions

The objective of this quality improvement project was to determine if the publication of the updated 2012 AHA/ASA aSAH Guidelines affected adherence, by Cleveland Clinic Critical Care Transport Team members, to those evidence based practice guidelines for blood pressure control for patients with subarachnoid hemorrhage, by comparing chart data from the period January through June 2012 with chart data for the period July through December 2012. Data obtained from the records included length of transport in minutes and blood pressures during transport. Number of blood pressures varied based on overall clinical status, discretion of the nurse practitioner and length of transport. The 137 patient records were separated into two groups according to trip completion date. There were 64 patients transported January through June and 73 patients transported July through December.

Descriptive statistics were used to analyze the data set. Table 1 provided the means and standard deviations of the duration of trip, number of blood pressure readings during transport, first blood pressure readings and final blood pressure readings for the overall group, pre-publication guideline group and post-publication guideline group. Final systolic blood pressure readings were classified as low (SBP 159 mmHg or below) and high (SBP 160 mmHg or above). Table 2 provided the distribution of high and low observations as a function of a period (January

– June and July – December). The data was reported as overall as well as pre-publication and post-publication. In both groups and overall the percentage of subjects with a SBP < 159 was about the same, 86%.

Statistical testing was done to see if there were on average any group differences in final blood pressure readings. Table 3 displayed the results of a t test of group differences in final blood pressure readings. While the mean of the measurements taken from July through December was 1.7 mmHg lower, the difference did not provide sufficient evidence of on-average group differences. The data was also tested for group differences in the percent of individuals with high (160 mmHg or above) systolic blood pressure readings. The observed difference was a decrease of 0.36 percent. However a chi-square test that publication of the guidelines affected blood pressure status was not statistically significant (p value=0.95).

The objective of this quality improvement project was to determine if the publication of the updated 2012 AHA/ASA aSAH Guidelines affected adherence, by Cleveland Clinic Critical Care Transport Team members, to those evidence based practice guidelines for blood pressure control for patients with subarachnoid hemorrhage, by comparing chart data from the period January through June 2012 with chart data for the period July through December 2012. After a statistical review of the data was completed it was determined that there was not a statistically significant difference in adequate systolic blood pressure management (SBP > 159 mmHg) following the July 2012 publication of the AHA/ASA guidelines.

Chapter Five: Summary

Project Summary

The incidence of aneurysmal subarachnoid hemorrhage (aSAH) occurs in approximately 10 - 15 per 100,000 (Labovitz et al., 2006 & Shea et al., 2007). Within twenty-four hours twenty-five percent of these patients die (AHA, 2012). Additionally two thirds have some neurological deficit and decreased quality of life (AHA, 2012). Re-bleeding is a serious complication prior to repair. The highest risk of re-bleeding occurs in the first twelve hours, most occurring in the first three hours with mortality rates as high as seventy percent (American Stroke Association (ASA), 2012). According to the ASA (2012), ultra-early blood pressure management is one of the most important interventions to prevent re-bleeding.

The objective of this quality improvement project was to determine if the publication of the updated 2012 AHA/ASA aSAH Guidelines affected adherence, by Cleveland Clinic Critical Care Transport Team members, to those evidence based practice guidelines for blood pressure control for patients with subarachnoid hemorrhage. After a statistical review of the data was completed it was determined that there was not a statistically significant difference in adequate systolic blood pressure management (SBP > 159 mmHg) after the publication of the updated guidelines. Patients transported by Cleveland Clinic Critical Care Transport with a diagnosis of aSAH have adequate blood pressure control eighty six percent of the time with no statistically differences before and after the publication of the updated guidelines.

Limitations

There were identified limitations that may have affected blood pressure control and outcomes that were not accounted for during this project due to time limitation of the project and lack of available data within the original dataset. The data used for the project was secondary

data extracted from a larger study looking at hematoma expansion and blood pressure control in patients with intracranial hemorrhage. The investigators of the original study did not collect data points for identified limitations. This database did not have identified limitations available, therefore requiring further retrospective chart review, which was not feasible for the time frame set for this project.

Identified limitations included duration of trip, the need for stabilization upon arrival to the bedside, in-flight emergencies, procedures completed during transport, medication chosen for blood pressure control and frequency of medication given based on onset of action. All of these limitations could impact blood pressure management during critical care transport.

Implications for Nursing Practice and to the DNP Essentials

The Essentials of Doctoral Education for Advanced Nursing Practice were consistently used throughout the project. Essentials I and III discusses the scientific underpinning for practice and clinical scholarship and analytical methods for evidence based practice (AACN, 2009). The nurse practitioner must be able to translate evidence into practice. Knowledge across disciplines must be used to optimize patient care. The updated AHA/ASA 2012 Guidelines on aSAH provide a guideline to implement evidence-based care. The risk of re-bleeding with an aSAH is highest in the first twelve hours post aneurysmal rupture and is associated with the highest morbidity and mortality. It has been established that the worst outcomes occur when re-bleeding occurs in the first three hours (AHA, 2012). The American Stroke Association states that the fatality rate in early rebleeding is seventy percent. Re-bleeding is currently one of the most treatable causes of poor outcomes with ultra-early blood pressure management being one of the important mainstays of treatment (American Stroke Association, 2012).

According to our analyzed data the Cleveland Clinic Critical Care Transport Team reaches adequate blood pressure control in approximately 86% of the time, not 100% percent of the time. This disparity may be due to many factors, one of them being lack of knowledge related to the importance of ultra-early blood pressure control in order to decrease the risk of re-bleeding. DNP Essential II looks at leadership for quality improvement and systems thinking (AACN, 2009). All nurse practitioners on the team need to recognize the importance of ultra-early blood pressure control in a SAH. The DNP prepared APRN is in a position to look for opportunities for improvement that advance the team forward, improving care provided by the nurse practitioner.

The next steps for the project would be looking into barriers in transport that may prevent adherence to the AHA/ASA 2012 Guidelines. As the team is a nurse practitioner lead team, it is vital that the findings of the project are conveyed to the group for discussion and reflection of practice. Presenting the AHA/ASA 2012 Guidelines would be essential in order to stress the importance of ultra-early blood pressure control. There are many challenges to practice in the transport environment. Overcoming these challenges and providing optimal care is essential (AHA, 2012).

The doctorally prepared advanced practice registered nurse (APRN) is in a great position to impact care of patients requiring critical care transport during the acute phase of illness. The Essentials of Doctoral Education (Essentials) were used throughout the project. There is a consistent use of most of the Essentials. Essential VIII prepares the APRN for advanced nursing practice and mastery in an area of nursing practice (AACN, 2009). Essential VIII is displayed in our everyday practice. The Cleveland Clinic Critical Care Transport Team is unique as it is an acute care nurse practitioner lead team. This allows the team to provide Individualized

evidenced-based care in order to optimize patient outcomes. The DNP prepared APRN can be a leader by analyzing the evidence, using existing standards of care to their maximum potential in the organization, or identifying gaps in the evidence and seeking assistance to gather new knowledge. There is opportunity to bridge the gap between existing evidence and evidence-based practice.

Conclusion

The incidence of aneurysmal subarachnoid hemorrhage (aSAH) occurs in approximately 10 - 15 per 100,000 (Labovitz et al., 2006 & Shea et al., 2007). Within twenty-four hours twenty-five percent of these patients die (AHA, 2012). Additionally two thirds have some neurological deficit and decreased quality of life (AHA, 2012). Re-bleeding is a serious complication prior to repair. The highest risk of re-bleeding occurs in the first twelve hours, most occurring in the first three hours with mortality rates as high as seventy percent (American Stroke Association (ASA), 2012). According to the ASA (2012), ultra-early blood pressure management is one of the most important interventions to prevent re-bleeding.

The purpose of the project was to determine if there was increased adherence to evidence based practice guidelines for systolic management in patients with acute aSAH after the publication of the 2012 AHA/ASA aSAH Guidelines. The data indicated that patients transported by Cleveland Clinic Critical Care Transport with a diagnosis of aSAH have adequate blood pressure control eighty six percent of the time with no statistically differences before and after the publication of the updated guidelines.

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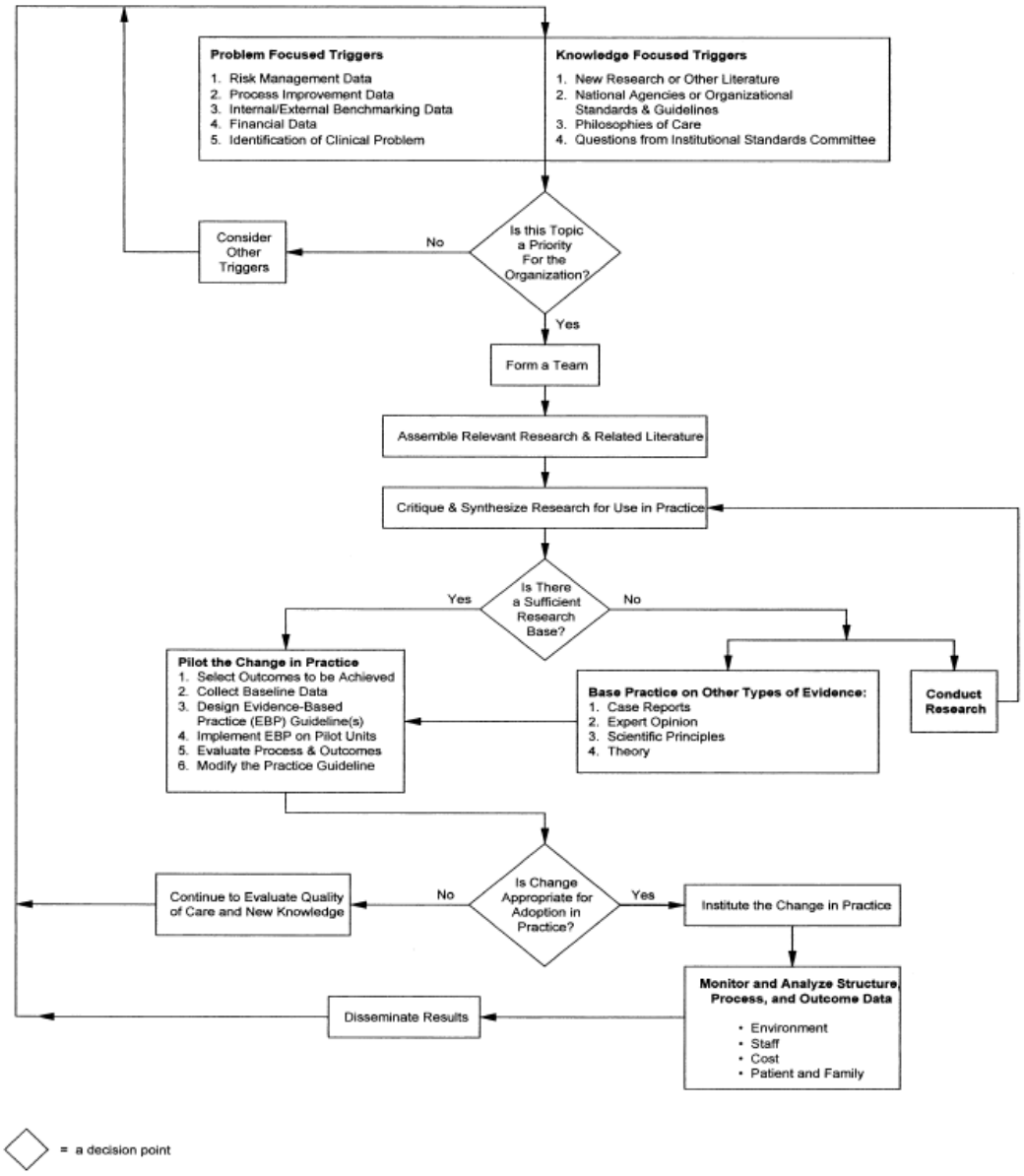
Appendix A



(Titler et al. 2001)